

PATENT ABSTRACTS OF JAPAN

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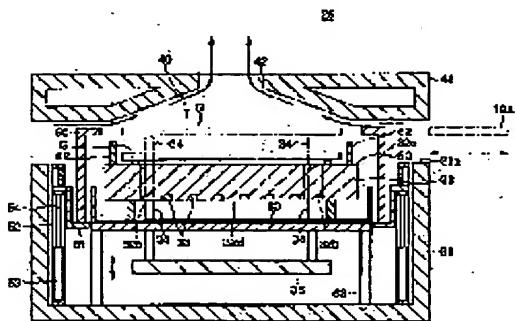
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(54) THERMAL TREATING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a thermal treating device wherein, even when a large object is thermally treated in-plane uniformity of processing temperature of the object to be processed is improved.

SOLUTION: A thermal treating device comprises a hot plate 32 on which a substrate G is placed, a heater 33 which, being press-fitted to the hot plate 32, heats the substrate G through the hot plate 32, and a reflection plate 60 which, provided on the rear surface and the side surface of the hot plate 32 while facing each other with an interval, reflects the heat radiated from the hot plate 32. In a placement surface 32c of the hot plate 32, an outside frame 62 enclosing the substrate G is provided.



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CLAIMS

[Claim(s)]

[Claim 1] It is the thermal treatment equipment which a processed object is arranged in moreover or the upper part, possesses the heating plate which heats a processed object, the heater which heats said heating plate, and the reflecting plate which reflects heat emitted from said heating plate, and is characterized by to have the base section which said reflecting plate countered a rear face of said heating plate, and has been arranged, and the side wall section countered and prepared in the side of said heating plate.

[Claim 2] Said side wall section is a thermal treatment equipment according to claim 1 characterized by the side and 1/3 of thickness of said heating plate, and portions of 1/2 overlapping.

[Claim 3] A thermal treatment equipment characterized by providing a heating plate which a processed object is arranged in moreover or the upper part, and heats a processed object, a heater which heats said heating plate, and an outer frame prepared so that said processed object might be surrounded into a processed object arrangement portion of said heating plate.

[Claim 4] A thermal treatment equipment which is equipped with the following, controls an air current which flows along the side of said heating plate according to an air current supplied in said processed space through said crevice when said exhaust air covering at the time of heat treatment and a crevice between said shutters are exhausted through said exhaust port, and is characterized by setting up so that temperature dispersion of said heating plate may become small. A heating plate which a processed object is arranged in moreover or the upper part, and heats a processed object A heater which heats said heating plate Exhaust air covering which has an exhaust port while being arranged through processing space above said heating plate A shutter which has been arranged so that said processing space may be surrounded, and was formed possible [an attitude] to said exhaust air covering

[Claim 5] A thermal treatment equipment according to claim 4 characterized by setting said exhaust air covering at the time of heat treatment, and a crevice between said shutters to 15-20mm.

[Claim 6] A shutter which has been arranged so that exhaust air covering characterized by providing the following and said processing space may be surrounded, and was formed possible [an attitude] to said exhaust air covering is provided. Said reflecting plate The base section which countered a rear face of said heating plate and has been arranged, and the side wall section countered and prepared in the side of said heating plate are provided. An air current which flows along the side of said heating plate according to an air current supplied in said processed space through said crevice in said exhaust air covering at the time of heat treatment and a crevice between said shutters when it exhausts through said exhaust port is controlled. A thermal treatment equipment characterized by setting up so that temperature dispersion of said heating plate may become small A heating plate which a processed object is arranged in moreover or the upper part, and heats a processed object A heater which heats said heating plate A reflecting plate which reflects heat emitted from said heating plate It is an exhaust port while being arranged through processing space in an outer frame prepared so that said processed object might be surrounded into a processed object arrangement portion of said heating plate, and the upper part of said heating plate. A thermal treatment equipment characterized by carrying out.

[Claim 7] The side wall section of said reflecting plate is a thermal treatment equipment according to claim 6 characterized by portions of the side and 1/3 of thickness of said heating plate, and 1/3 overlapping.

[Claim 8] A thermal treatment equipment according to claim 6 or 7 characterized by setting said exhaust air covering at the time of heat treatment, and a crevice between said shutters to 15-20mm.

[Claim 9] It is the thermal treatment equipment which a processed object is arranged in moreover or the upper part, possesses a heating plate which heats a processed object, and a heater formed in said heating plate, and is characterized by pressing said heater fit in a crevice formed in said heating plate.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] This invention relates to the thermal treatment equipment which heats and processes a substrate for example, with a large-sized LCD substrate etc.

[0002]

[Description of the Prior Art] In manufacture of a liquid crystal display (LCD), photoresist liquid is applied to a glass LCD substrate, a resist film is formed, a resist film is exposed corresponding to a circuit pattern, and a circuit pattern is formed by the so-called photolithography technology of carrying out the development of this.

[0003] After more specifically performing hydrophobing processing to a LCD substrate with an adhesion processor after a washing station washes a LCD substrate, and cooling by cooling processing treatment subsequently, spreading formation of the photoresist film is carried out on the surface of a LCD substrate with a resist coater. Then, a photoresist film is heated with a thermal treatment equipment, baking processing is performed, a pattern predetermined with an aligner is exposed, and after applying a developer to the LCD substrate after exposure with a developer and developing this, washout and a development are performed for the developer by the rinse.

[0004] It is arranged so that processing space may be formed between the hot plate which lays a LCD substrate as a thermal treatment equipment which heats a LCD substrate in the above developments, for example, the heating heater which heats a LCD substrate through this hot plate, and a hot plate, and the thing equipped with the shutter intercepted possible [exhaust air covering which has an exhaust port in the center of the ceiling section, and closing motion of said processing space] is used.

[0005]

[Problem(s) to be Solved by the Invention] By the way, the demand of enlargement is increasing recently increasingly and, as for the LCD substrate, a thing like 840x650mm enlarged remarkably is called for from 650x550 conventionalmm, for example. Thus, if a LCD substrate is enlarged, when it heat-treats by heating a LCD substrate as mentioned above, the homogeneity within a field of the processing temperature of a LCD substrate will tend to worsen. For example, it is in the orientation for the temperature gradient between a center section and the periphery section of a LCD substrate to become large according to enlargement of a LCD substrate.

[0006] Therefore, it is required to control more strictly the effect on the processing temperature in a thermal treatment equipment with enlargement of a LCD substrate. Although many things are considered as a factor of the variation in the temperature distribution of a LCD substrate, the thermolysis from a hot plate can be considered as one factor. That is, since it is exposed into the ambient atmosphere in processing space, in order that thermolysis may tend to occur, a temperature gradient tends to produce the base and side wall of a hot plate between a center section and the periphery section of a hot plate. According to the temperature gradient of such a hot plate, finally, between a center section and the periphery section of a LCD substrate, a temperature gradient arises and the heat homogeneity of a LCD substrate falls.

[0007] Moreover, the exhaust air at the time of heat treatment is also mentioned as a cause. In the baking processing which heats the photoresist film formed on the above-mentioned LCD substrate, since the solvent in a photoresist film (for example, thinner) volatilizes with heating, in order to remove this from processing space, exhaust air is performed from the exhaust port established in exhaust air covering. A temperature gradient arises between a center section and the periphery section of a hot plate or a LCD substrate according to the so-called disturbance to which the temperature of the outside of a hot plate or a LCD substrate falls by the flow of the air generated with this exhaust air.

[0008] By the way, what the hot plate made build in a heating heater by cast, and was fabricated is used conventionally. Although it is calculated with enlargement of a LCD substrate in recent years that heat responsibility of a hot plate is more high, and thickness is thin, and it is lightweight, since thickness can be made thin from the limit on manufacture to about 40mm, this cast type of hot plate has bad heat responsibility, and lightweight-izing is difficult for it, and it has the defect to which unit elevation becomes high.

[0009] This invention is made in view of this situation, and also when heat-treating a large-scale processed object, it aims at offering the thermal treatment equipment which can be improved in the

homogeneity within a field of the processing temperature of a processed object.

[0010]

[Means for Solving the Problem] A heating plate with which a processed object is arranged in the top or upper part, and the 1st invention heats a processed object in order to solve the above-mentioned technical problem. A heater which heats said heating plate, and a reflecting plate which reflects heat emitted from said heating plate are provided. Said reflecting plate A thermal treatment equipment characterized by having the base section which countered a rear face of said heating plate and has been arranged, and the side wall section countered and prepared in the side of said heating plate is offered.

[0011] A thermal treatment equipment with which the 2nd invention is characterized by the side and 1/3 of thickness of said heating plate, and portions of 1/2 overlapping in the 1st invention in said side wall section is offered.

[0012] A processed object is arranged in the top or upper part, and the 3rd invention offers a thermal treatment equipment characterized by providing a heating plate which heats a processed object, a heater which heats said heating plate, and an outer frame prepared so that said processed object might be surrounded into a processed object arrangement portion of said heating plate.

[0013] A heating plate with which a processed object is arranged in the top or upper part, and the 4th invention heats a processed object. A heater which heats said heating plate, and exhaust air covering which has an exhaust port while being arranged through processing space above said heating plate, A shutter which has been arranged so that said processing space may be surrounded, and was formed possible [an attitude] to said exhaust air covering is provided. Said exhaust air covering at the time of heat treatment, and a crevice between said shutters according to an air current supplied in said processed space through said crevice when it exhausts through said exhaust port An air current which flows along the side of said heating plate is controlled, and a thermal treatment equipment characterized by setting up so that temperature dispersion of said heating plate may become small is offered.

[0014] The 5th invention offers a thermal treatment equipment characterized by setting said exhaust air covering at the time of heat treatment, and a crevice between said shutters to 15-20mm in the 4th invention.

[0015] A heating plate with which a processed object is arranged in the top or upper part, and the 6th invention heats a processed object. A heater which heats said heating plate, and a reflecting plate which reflects heat emitted from said heating plate, An outer frame prepared so that said processed object might be surrounded into a processed object arrangement portion of said heating plate. Exhaust air covering which has an exhaust port while being arranged through processing space above said heating plate, A shutter which has been arranged so that said processing space may be surrounded, and was formed possible [an attitude] to said exhaust air covering is provided. Said reflecting plate It has the base section which countered a rear face of said heating plate and has been arranged, and the side wall section countered and prepared in the side of said heating plate. Said exhaust air covering at the time of heat treatment, and a crevice between said shutters according to an air current supplied in said processed space through said crevice when it exhausts through said exhaust port A thermal treatment equipment characterized by having controlled an air current which flows along the side of said heating plate, and setting up so that temperature dispersion of said heating plate may become small. A thermal treatment equipment characterized by carrying out is offered.

[0016] A thermal treatment equipment with which the 7th invention is characterized by the side and 1/3 of thickness of said heating plate, and portions of 1/2 overlapping in the 6th invention in the side wall section of said reflecting plate is offered.

[0017] The 8th invention offers a thermal treatment equipment characterized by setting said exhaust air covering at the time of heat treatment, and a crevice between said shutters to 15-20mm in the 6th invention or the 7th invention.

[0018] A processed object is arranged in the top or upper part, the 9th invention possesses a heating plate which heats a processed object, and a heater formed in said heating plate, and a thermal treatment equipment characterized by pressing said heater fit in a crevice formed in said heating plate is offered.

[0019] Since it has a reflecting plate which reflects heat emitted from a heating plate according to the 1st invention, a heating plate can be made to reflect heat emitted from a heating plate. And since it has the base section by which this reflecting plate countered a rear face of an installation base, and has been arranged, and the side wall section countered and prepared in the side of said installation base and a reflecting plate will be formed corresponding to a portion with much thermolysis of a heating plate, a portion with much thermolysis can be made to reflect heat. Therefore, the heat homogeneity of a heating

plate can be raised.

[0020] Like the 2nd invention, when making the side wall section of a reflecting plate the side and 1/3 of thickness of a heating plate, and portions of 1/2 overlap, it can prevent both that temperature becomes high too much with a temperature fall and a reflecting plate by thermolysis by periphery of a heating plate, and the heat homogeneity of a heating plate can be raised further.

[0021] Since it has an outer frame prepared so that a processed object might be surrounded into a processed object arrangement portion of a heating plate according to the 3rd invention, it is stopped that air goes into the perimeter of a processed object. Therefore, disturbance can be suppressed and the homogeneity within a field of processing temperature of a processed object can be raised.

[0022] In the 4th invention, although exhausted in the state of so-called semi closed which brought a shutter close to exhaust air covering, and intercepted processing space imperfectly at the time of heat treatment where a crevice is left between exhaust air covering and a shutter, an air current supplied in processing space through a crevice by exhaust air and an air current which flows upwards along the side of a heating plate arise in this case. If there are many air currents which flow along the side of a plate among these, heat of the side of a heating plate will be taken too much, and the heat homogeneity of an installation base will be spoiled. Then, since it has set up so that an air current which flows along the side of said heating plate may be controlled and temperature dispersion of a heating plate may become small according to an air current to which a crevice between exhaust air covering and a shutter is supplied in processed space through there, it is controlled that heat is taken from the side of a heating plate, and it can raise the heat homogeneity of a heating plate. In this case, although it is based also on equipment layout in order to demonstrate such a function, it is desirable like the 5th invention that a crevice between exhaust air covering and a shutter is 15–20mm.

[0023] A reflecting plate which reflects heat emitted from a heating plate of the 1st invention according to the 6th invention, An outer frame prepared so that said processed object might be surrounded into a processed object arrangement portion of a heating plate of the 3rd invention is prepared. Exhaust air covering at the time of heat treatment, and a crevice between shutters like the 4th invention according to and an air current supplied in processed space through the crevice when it exhausts through an exhaust port An air current which flows along the side of a heating plate is controlled, and since it set up so that temperature dispersion of said heating plate might become small, these synergistic effects can raise the heat homogeneity of a heating plate remarkably.

[0024] According to the 7th invention and the 8th invention, since the 2nd invention and the 5th invention were applied to the 6th invention, respectively, the heat homogeneity of a heating plate can be raised further further.

[0025] Since a heater is pressed fit in a crevice formed in a heating plate according to the 9th invention, it is not necessary to thicken a heating plate like the conventional cast type. Therefore, heat responsibility can manufacture a heating plate in thickness strong against disturbance it is good and possible [lightweightizing] rather than before.

[0026]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained to details with reference to an accompanying drawing. Drawing 1 is the perspective diagram showing spreading and the development system of the LCD substrate with which this invention is applied.

[0027] This spreading and development system are equipped with the conveyance device 3 for conveying a LCD substrate between the processing section 2 equipped with the cassette station 1 in which the cassette C which holds two or more substrates G is laid, and two or more processing units for performing a series of processings which include resist spreading and development in Substrate G, and the cassette C on the cassette station 1 and the processing section 2. And carrying-in appearance of Cassette C is performed at the cassette station 1. Moreover, in the conveyance way 12 top in which the conveyance device 3 was formed along the array direction of a cassette, it has the movable conveyance arm 11 and conveyance of Substrate G is performed by this conveyance arm 11 between Cassette C and the processing section 2.

[0028] The processing section 2 is divided into pre-stage 2a and post-stage 2b, it has the conveyance way units 15 and 16 in the center, respectively, and each processing unit is arranged in the both sides of these conveyances way. And the junction section 17 is formed among these.

[0029] Pre-stage 2a is equipped with the movable main transport device 18 along with the conveyance way unit 15, 2 sets of heat-treatment units 21 which come to carry out a laminating to two steps of upper and lower sides, the adhesion process unit 22 which adjoined it and was formed up and down, and

the refrigeration unit 23 are arranged at the one side of the conveyance way 15, and the washing unit 24 and the development unit 25 are arranged at the other side.

[0030] On the other hand, 3 sets of heat-treatment units 28 which post-stage 2b is equipped with the movable main transport device 19 along with the conveyance way unit 16, and come to carry out a two-step laminating to the one side of the conveyance way unit 16 are arranged, and the circumference resist removal unit 27 which removes the resist of the periphery of the resist spreading unit 26 and Substrate G is arranged at the other side of the conveyance way unit 16. The heat-treatment unit 28 performs the prebaking for stabilization of a resist, postexposure BEKU after exposure, and postbake processing after development. In addition, the interface section 30 for delivering Substrate G between aligners (not shown) is formed in the back end of post-stage 2b.

[0031] The cooling processing unit 29 which comes to carry out a two-step laminating is formed in the junction section 17 in the location which adjoined the heat-treatment unit 28, and the drug solution supply unit 81 and the transport-device admission passage 82 are established in the location which counters the cooling processing unit 29.

[0032] The above-mentioned main transport device 18 has carrying in and taking out of Substrate G to each processing unit of pre-stage 2a, and the function to deliver Substrate G between the junction sections 17 further while delivering Substrate G between the arms 11 of the conveyance device 3. Moreover, the main transport device 19 has carrying in and taking out of Substrate G to each processing unit of post-stage 2b, and the function to deliver the substrate G between the interface sections 30 further while delivering Substrate G between the junction sections 17.

[0033] Thus, by collecting each processing unit and unifying, space-saving-izing and the increase in efficiency of processing can be attained.

[0034] Thus, it sets to spreading and the development system constituted. The substrate G in Cassette C is conveyed by the processing section 2. In the processing section 2 First, after washing processing was carried out by the washing unit 24 and stoving was carried out by one of the heat-treatment units 21. In order to raise fixable [of a resist], hydrophobing processing is carried out with an adhesion process unit 22, a resist is applied in the resist spreading unit 26 after cooling with a refrigeration unit 23, and the excessive resist of the periphery of Substrate G is removed in the circumference resist removal unit 27. Then, after prebaking processing of the substrate G is carried out by one of the heat-treatment units 28 and being cooled with a refrigeration unit 29, it is conveyed by the aligner through the interface section 30, and a predetermined pattern is exposed there. And it is again carried in through the interface section 30, and postexposure BEKU processing is performed by one of the heat-treatment units 28. Then, the development of the substrate G cooled with the refrigeration unit 29 is carried out in the development unit 25, and a predetermined circuit pattern is formed. The substrate G by which the development was carried out is held in the predetermined cassette on the cassette station 1 according to the main transport device 18 and the conveyance device 3.

[0035] Next, the heat-treatment units 21 and 28 as a thermal treatment equipment concerning the gestalt of this operation used for above-mentioned spreading and development system are explained. The case 31 where face the conveyance way 16 side and it has opening 31a as the heat-treatment units 21 and 28 are shown in drawing 2 , Where the processing space 40 is formed between the hot plate 32 which heats the substrate G held in the case 31, and a hot plate 32 The shutter 50 which has been arranged so that the exhaust air covering 41 arranged so that the upper part of a case 31 may be covered, and the processing space 40 may be surrounded, and was formed possible [an attitude] to the exhaust air covering 41 is provided. And the exhaust port 42 is established in the center of the ceiling section of the exhaust air covering 41.

[0036] The hot plate 32 is formed with the aluminium alloy etc. In this example, the thickness of a hot plate 32 is 30mm. The heater 33 which heats a hot plate 32 is formed in the rear-face side of a hot plate 32. It is laid under the hot plate 32 as by being pressed fit in two or more crevice 32a formed in 32d side of rear faces of a hot plate 32 as shown in nothing and drawing 3 (a) shows the shape of heater 33 pipe to drawing 3 (b).

[0037] Furthermore, the temperature sensor which is not illustrated is formed in a hot plate 32, and it feeds back to the control section which does not illustrate processing temperature, for example, a setup to a predetermined processing temperature of 120-150 degrees C is attained.

[0038] Four through tube 32b is prepared in the hot plate 32. The support pin 34 for supporting Substrate G at the time of substrate delivery, respectively is ****(ed) by these through tube 32b. The support pin 34 is held by the attachment component 35 in which the hot plate 32 was formed caudad.

The attachment component 35 is connected with the elevator style (not shown). Therefore, the support pin 34 can appear frequently to surface 32c of a hot plate 32 by making it go up and down an attachment component 35 by the elevator style.

[0039] In addition, Substrate G may be a pro squeak tea type held in the upper part, without being laid in a hot plate 32 and contacting a hot plate 32 with the support pin 34 or a spacer (not shown).

[0040] In the case 31 of a thermal treatment equipment 26, the reflecting plate 60 which reflects the heat emitted from the hot plate 32 is formed. As shown in drawing 4, 32d of rear faces of a hot plate 32 is countered, and this reflecting plate 60 counters base section 60a arranged by separating a predetermined gap, and side 32e of a hot plate 32, and has side wall section 60b arranged by separating a predetermined gap.

[0041] A reflecting plate 60 is laid on the base member 63 laid on the base of a case 31, as shown in drawing 2. Furthermore, as shown in drawing 4, on base section 60a of a reflecting plate 60, a hot plate 32 is laid through a spacer 61. Thereby, between base section 60a of a hot plate 32 and a reflecting plate 60 is estranged. Although especially the gap between a hot plate 32 and a reflecting plate 60 is not limited, it is desirable to choose suitably so that the heat homogeneity of a hot plate 32 may become the highest.

[0042] The outer frame 62 is formed in surface 32c of a hot plate 32 so that some gap may be set and the perimeter of Substrate G may be surrounded. Although especially the height of an outer frame 62 is not limited, it is 5mm that what is necessary is just more highly than the height of the surface of Substrate G.

[0043] A shutter 50 consists of a configuration where inner sense level piece 50b was prepared in the upper limit of square shape tubed main part 50a, as shown in drawing 5. The blanket 51 protrudes on the lower limit section of the center of both sides of this main part 50a, respectively. The blanket 51 is held free [rise and fall] by the guide member 52 set up by the base of a case 31, as shown in drawing 6. Furthermore, a blanket 51 is connected with the piston rod 54 of the air cylinder 53 as a rise-and-fall means, and rise-and-fall migration is constituted by the drive of an air cylinder 53 possible. Therefore, you can make it able to go up and down a shutter 50, and it can be made to move to the exhaust air covering 40 by the air cylinder 53.

[0044] The stopper 55 is attached in the upper limit section of the guide member 52. This stopper 55 stops a blanket 51, when raising a blanket 51, and he stops a shutter 50 by the position. As shown in drawing 7, the rise halt location of a shutter 50 is set up so that Crevice D may be formed between a shutter 50 and the exhaust air covering 41.

[0045] In heat treatment using this heat-treatment unit 26, it exhausts as the so-called semi closed condition which the shutter 50 was raised most, and left Crevice D between the exhaust air covering 41 and a shutter 50, and was imperfectly intercepted in the processing space 40. Under the present circumstances, as shown in drawing 7, the air current (henceforth the supply air current A) supplied in the processing space 40 through Crevice D by exhaust air and the air current (henceforth the side air current B) which flows along with side 32e of a hot plate 32 arise. Among these, if there are many side air currents B, the heat of side 32e of a hot plate 32 will be taken too much, the temperature gradient between the core of a hot plate 32 and a periphery becomes large, heat homogeneity is spoiled, and the homogeneity within a field of the processing temperature of Substrate G gets worse as a result.

[0046] By the way, if exhaust air is fixed, if the supply air current A is made [many], the side air current B will decrease, and since the supply air current A and the side air current B are produced with exhaust air as mentioned above, when the supply air current A is lessened, it has the relation whose side air current B increases on the contrary. The amount of the supply air current A can be fluctuated by changing the crevice D between the exhaust air covering 41 and a shutter 50. Therefore, the supply air current A is relatively made [many], and the side air current B is controlled according to this supply air current A, and Crevice D is set up so that the temperature gradient in a hot plate 32 may become small. Specifically, Crevice D is set as 15-20mm.

[0047] In addition, the exhaust air means which is not illustrated is connected to an exhaust port 42, and it is constituted so that the ambient atmosphere in the processing space 40 can be exhausted outside.

[0048] Since the heat-treatment unit 26 constituted as mentioned above has the reflecting plate 60 which reflects the heat emitted from the hot plate 32, when heat-treating to Substrate G, the emitted heat is reflected toward a hot plate 32. And since a reflecting plate 60 counters 32d of bases of a hot plate 32, and side 32e, respectively, is estranged to them and formed in them, it can reflect heat toward 32d of bases with much radiation of heat, and side 32e. Thereby, the local temperature fall of a hot plate

32, especially the temperature fall of the periphery of a hot plate 32 can be controlled. Consequently, the heat homogeneity of a hot plate 32 can be raised.

[0049] As shown in drawing 4, since arranging so that parts may overlap mutually can make the thermolysis from side 32b of a hot plate 32 perform moderately, side wall section 60b of a reflecting plate 60 and side 32b of a hot plate 32 have it. [desirable] In this case, it is desirable to set to 1 / 3 - 1/2 of thickness (this example 30mm) (this example 10-15mm) the height (henceforth lap height H) which both overlap. [of a hot plate 22] It is because the temperature of the periphery of a hot plate 32 will become high too much and the heat homogeneity of a hot plate 32 will be spoiled on the contrary by reflection of the heat emitted from the hot plate 32, if lap height H is too high.

[0050] Moreover, in the heat-treatment unit 26, since the outer frame 62 prepared in surface 32c of a hot plate 32 so that Substrate G might be surrounded stops that air goes into the perimeter of Substrate G, it can prevent that the temperature of the outside of Substrate G falls according to the flow of the air generated with exhaust air, and the so-called disturbance, consequently the homogeneity within a field of the processing temperature of Substrate G can be raised.

[0051] Moreover, the case where a shutter 50 is most raised in the heat-treatment unit 26 at the time of heat treatment, Since it is set up so that the crevice D between the exhaust air covering 41 and a shutter 50 may control the side air current B according to the supply air current A and the temperature gradient in a hot plate 32 may become small It can prevent that heat is rapidly taken from side 32e of a hot plate 32 according to the rapid side air current B, and the temperature gradient between a center section and the periphery of a hot plate 32 can be made small. Therefore, the heat homogeneity of a hot plate 32 improves and the homogeneity within a field of the processing temperature of Substrate G improves as a result. In this case, in order to demonstrate such a function, it is desirable to set the crevice between the exhaust air covering 41 and a shutter 50 as 15-20mm.

[0052] Furthermore, since it is the so-called press fit type under which the heater 33 was made to lay by press fit, a hot plate 32 does not have constraint (40mm or more) of the thickness on manufacture like a cast type, and can be manufactured more thinly. Therefore, while being able to make a hot plate 32 thin and being able to improve heat responsibility, lightweight-ization can be attained and the height of the heat-treatment unit 26 can be reduced further. Thus, as the thickness of a hot plate 32 is thin, in view of the viewpoint of an equipment miniaturization and heat responsibility, it is more desirable. However, since it becomes easy to be influenced of disturbance in 25mm or less, the thickness of about 30mm is the optimal, for example, in view of both the miniaturization of equipment, and heat homogeneity.

[0053] In addition, although heat conduction was conventionally considered to worsen by the layer of the air which produces a press fit type hot plate between the crevices and heaters which were formed in the plate, it became clear in fact the effect of [such] accepted but for it to have been fully able to use.

[0054] The heat-treatment unit 26 concerning the gestalt of this operation can raise synthetically the homogeneity within a field of the processing temperature of Substrate G by combining the above-mentioned various technology as explained above. Specifically, heat homogeneity can be attained in a 1.5-degree C range about the 840x650mm remarkable large-sized substrate G.

TECHNICAL FIELD

[A technical field to which invention belongs] This invention relates to a thermal treatment equipment which heats and processes a substrate for example, with a large-sized LCD substrate etc.

[Translation done.]

PRIOR ART

[Description of the Prior Art] In manufacture of a liquid crystal display (LCD), photoresist liquid is applied to a glass LCD substrate, a resist film is formed, a resist film is exposed corresponding to a circuit pattern, and a circuit pattern is formed by the so-called photolithography technology of carrying out the development of this.

[0003] After more specifically performing hydrophobing processing to a LCD substrate with an adhesion processor after a washing station washes a LCD substrate, and cooling by cooling processing treatment subsequently, spreading formation of the photoresist film is carried out on the surface of a LCD substrate with a resist coater. Then, a photoresist film is heated with a thermal treatment equipment, baking processing is performed, a pattern predetermined with an aligner is exposed, and after applying a developer to the LCD substrate after exposure with a developer and developing this, washout and a development are performed for the developer by the rinse.

[0004] It is arranged so that processing space may be formed between the hot plate which lays a LCD substrate as a thermal treatment equipment which heats a LCD substrate in the above developments, for example, the heating heater which heats a LCD substrate through this hot plate, and a hot plate, and the thing equipped with the shutter intercepted possible [exhaust air covering which has an exhaust port in the center of the ceiling section, and closing motion of said processing space] is used.

[0005]

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] Since it has the base section which the heating plate could be made to reflect the heat emitted from the heating plate, and this reflecting plate countered the rear face of an installation base, and has been arranged, and the side wall section countered and prepared in the side of said installation base according to the 1st invention as explained above, a portion with much thermolysis can be made to reflect heat. Therefore, the heat homogeneity of a heating plate can be raised.

[0058] In this case, like the 2nd invention, when making the side wall section of a reflecting plate the side and 1/3 of thickness of a heating plate, and the portions of 1/2 overlap, it can prevent both that temperature becomes high too much with the temperature fall and reflecting plate by thermolysis by the periphery of a heating plate, and the heat homogeneity of a heating plate can be raised further.

[0059] Since it has the outer frame prepared so that a processed object might be surrounded into the processed object arrangement portion of a heating plate according to the 3rd invention, it is stopped that air goes into the perimeter of a processed object, and it can raise the heat homogeneity within a field of the processing temperature of a processed object.

[0060] Since according to the 4th invention it has set up so that the air current which flows along the side of said heating plate may be controlled and temperature dispersion of a heating plate may become small according to the air current to which the crevice between exhaust air covering and a shutter is supplied in processed space through there, it is controlled that heat is taken from the side of a heating plate, and it can raise the heat homogeneity of a heating plate. Although based also on equipment layout, specifically, it is desirable like the 5th invention to set the crevice between exhaust air covering and a shutter as 15-20mm.

[0061] The reflecting plate which reflects the heat emitted from the heating plate of the 1st invention according to the 6th invention, The outer frame prepared so that said processed object might be surrounded into the processed object arrangement portion of the heating plate of the 3rd invention is prepared. Exhaust air covering at the time of heat treatment, and the crevice between shutters like the 4th invention according to and the air current supplied in processed space through the crevice when it exhausts through an exhaust port The air current which flows along the side of a heating plate is controlled, and since it set up so that temperature dispersion of said heating plate might become small, these synergistic effects can raise the heat homogeneity of a heating plate remarkably.

[0062] According to the 7th invention and the 8th invention, since the 2nd invention and the 5th invention were applied to the 6th invention, respectively, the heat homogeneity of a heating plate can be raised further further.

[0063] Since a heater is pressed fit in the crevice formed in the heating plate according to the 9th invention, it is not necessary to thicken a heating plate like the conventional cast type. Therefore, heat responsibility can manufacture a heating plate in thickness strong against disturbance it is good and possible [lightweight-izing] rather than before.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, the demand of enlargement is increasing recently and, as for the LCD substrate, a thing like 840x650mm enlarged remarkably is called for from 650x550 conventional mm, for example. Thus, if a LCD substrate is enlarged, when it heat-treats by heating a LCD substrate as mentioned above, the homogeneity within a field of the processing temperature of a LCD substrate will tend to worsen. For example, it is in the orientation for the temperature gradient between a center section and the periphery section of a LCD substrate to become large according to enlargement of a LCD substrate.

[0006] Therefore, it is required to control more strictly the effect on the processing temperature in a thermal treatment equipment with enlargement of a LCD substrate. Although many things are considered as a factor of the variation in the temperature distribution of a LCD substrate, the thermolysis from a hot plate can be considered as one factor. That is, since it is exposed into the ambient atmosphere in processing space, in order that thermolysis may tend to occur, a temperature gradient tends to produce the base and side wall of a hot plate between a center section and the periphery section of a hot plate. According to the temperature gradient of such a hot plate, finally, between a center section and the periphery section of a LCD substrate, a temperature gradient arises and the heat homogeneity of a LCD substrate falls.

[0007] Moreover, the exhaust air at the time of heat treatment is also mentioned as a cause. In the baking processing which heats the photoresist film formed on the above-mentioned LCD substrate, since the solvent in a photoresist film (for example, thinner) volatilizes with heating, in order to remove this from processing space, exhaust air is performed from the exhaust port established in exhaust air covering. A temperature gradient arises between a center section and the periphery section of a hot plate or a LCD substrate according to the so-called disturbance to which the temperature of the outside of a hot plate or a LCD substrate falls by the flow of the air generated with this exhaust air.

[0008] By the way, what the hot plate made build in a heating heater by cast, and was fabricated is used conventionally. Although it is calculated with enlargement of a LCD substrate in recent years that heat responsibility of a hot plate is more high, and thickness is thin, and it is lightweight, since thickness can be made thin from the limit on manufacture to about 40mm, this cast type of hot plate has bad heat responsibility, and lightweight-izing is difficult for it, and it has the defect to which unit elevation becomes high.

[0009] This invention is made in view of this situation, and also when heat-treating a large-scale processed object, it aims at offering the thermal treatment equipment which can be improved in the homogeneity within a field of the processing temperature of a processed object.

[Translation done.]

MEANS

[Means for Solving the Problem] A heating plate with which a processed object is arranged in the top or upper part, and the 1st invention heats a processed object in order to solve the above-mentioned technical problem. A heater which heats said heating plate, and a reflecting plate which reflects heat emitted from said heating plate are provided. Said reflecting plate A thermal treatment equipment characterized by having the base section which countered a rear face of said heating plate and has been arranged, and the side wall section countered and prepared in the side of said heating plate is offered.

[0011] A thermal treatment equipment with which the 2nd invention is characterized by the side and 1/3 of thickness of said heating plate, and portions of 1/2 overlapping in the 1st invention in said side wall section is offered.

[0012] A processed object is arranged in the top or upper part, and the 3rd invention offers a thermal treatment equipment characterized by providing a heating plate which heats a processed object, a heater which heats said heating plate, and an outer frame prepared so that said processed object might be surrounded into a processed object arrangement portion of said heating plate.

[0013] A heating plate with which a processed object is arranged in the top or upper part, and the 4th invention heats a processed object, A heater which heats said heating plate, and exhaust air covering which has an exhaust port while being arranged through processing space above said heating plate, A shutter which has been arranged so that said processing space may be surrounded, and was formed possible [an attitude] to said exhaust air covering is provided. Said exhaust air covering at the time of heat treatment, and a crevice between said shutters according to an air current supplied in said processed space through said crevice when it exhausts through said exhaust port An air current which flows along the side of said heating plate is controlled, and a thermal treatment equipment characterized by setting up so that temperature dispersion of said heating plate may become small is offered.

[0014] The 5th invention offers a thermal treatment equipment characterized by setting said exhaust air covering at the time of heat treatment, and a crevice between said shutters to 15-20mm in the 4th invention.

[0015] A heating plate with which a processed object is arranged in the top or upper part, and the 6th invention heats a processed object, A heater which heats said heating plate, and a reflecting plate which reflects heat emitted from said heating plate, An outer frame prepared so that said processed object might be surrounded into a processed object arrangement portion of said heating plate, Exhaust air covering which has an exhaust port while being arranged through processing space above said heating plate, A shutter which has been arranged so that said processing space may be surrounded, and was formed possible [an attitude] to said exhaust air covering is provided. Said reflecting plate It has the base section which countered a rear face of said heating plate and has been arranged, and the side wall section countered and prepared in the side of said heating plate. Said exhaust air covering at the time of heat treatment, and a crevice between said shutters according to an air current supplied in said processed space through said crevice when it exhausts through said exhaust port A thermal treatment equipment characterized by having controlled an air current which flows along the side of said heating plate, and setting up so that temperature dispersion of said heating plate may become small. A thermal treatment equipment characterized by carrying out is offered.

[0016] A thermal treatment equipment with which the 7th invention is characterized by the side and 1/3 of thickness of said heating plate, and portions of 1/2 overlapping in the 6th invention in the side wall section of said reflecting plate is offered.

[0017] The 8th invention offers a thermal treatment equipment characterized by setting said exhaust air covering at the time of heat treatment, and a crevice between said shutters to 15-20mm in the 6th invention or the 7th invention.

[0018] A processed object is arranged in the top or upper part, the 9th invention possesses a heating plate which heats a processed object, and a heater formed in said heating plate, and a thermal treatment equipment characterized by pressing said heater fit in a crevice formed in said heating plate is

[0019] Since it has a reflecting plate which reflects heat emitted from a heating plate according to the 1st invention, a heating plate can be made to reflect heat emitted from a heating plate. And since it has the base section by which this reflecting plate countered a rear face of an installation base, and has been arranged, and the side wall section countered and prepared in the side of said installation base and a reflecting plate will be formed corresponding to a portion with much thermolysis of a heating plate, a portion with much thermolysis can be made to reflect heat. Therefore, the heat homogeneity of a heating plate can be raised.

[0020] Like the 2nd invention, when making the side wall section of a reflecting plate the side and 1/3 of thickness of a heating plate, and portions of 1/2 overlap, it can prevent both that temperature becomes high too much with a temperature fall and a reflecting plate by thermolysis by periphery of a heating plate, and the heat homogeneity of a heating plate can be raised further.

[0021] Since it has an outer frame prepared so that a processed object might be surrounded into a processed object arrangement portion of a heating plate according to the 3rd invention, it is stopped that air goes into the perimeter of a processed object. Therefore, disturbance can be suppressed and the homogeneity within a field of processing temperature of a processed object can be raised.

[0022] In the 4th invention, although exhausted in the state of so-called semi closed which brought a shutter close to exhaust air covering, and intercepted processing space imperfectly at the time of heat treatment where a crevice is left between exhaust air covering and a shutter, an air current supplied in processing space through a crevice by exhaust air and an air current which flows upwards along the side of a heating plate arise in this case. If there are many air currents which flow along the side of a plate among these, heat of the side of a heating plate will be taken too much, and the heat homogeneity of an installation base will be spoiled. Then, since it has set up so that an air current which flows along the side of said heating plate may be controlled and temperature dispersion of a heating plate may become small according to an air current between exhaust air covering and a shutter is supplied in processed space through there, it is controlled that heat is taken from the side of a heating plate, and it can raise the heat homogeneity of a heating plate. In this case, although it is based also on equipment layout in order to demonstrate such a function, it is desirable like the 5th invention that a crevice between exhaust air covering and a shutter is 15–20mm.

[0023] A reflecting plate which reflects heat emitted from a heating plate of the 1st invention according to the 6th invention. An outer frame prepared so that said processed object might be surrounded into a processed object arrangement portion of a heating plate of the 3rd invention is prepared. Exhaust air covering at the time of heat treatment, and a crevice between shutters like the 4th invention according to and an air current supplied in processed space through the crevice when it exhausts through an exhaust port. An air current which flows along the side of a heating plate is controlled, and since it set up so that temperature dispersion of said heating plate might become small, these synergistic effects can raise the heat homogeneity of a heating plate remarkably.

[0024] According to the 7th invention and the 8th invention, since the 2nd invention and the 5th invention were applied to the 6th invention, respectively, the heat homogeneity of a heating plate can be raised further further.

[0025] Since a heater is pressed fit in a crevice formed in a heating plate according to the 9th invention, it is not necessary to thicken a heating plate like the conventional cast type. Therefore, heat responsibility can manufacture a heating plate in thickness strong against disturbance it is good and possible [lightweight-izing] rather than before.

[0026] [Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained to details with reference to an accompanying drawing. Drawing 1 is the perspective diagram showing spreading and the development system of the LCD substrate with which this invention is applied.

[0027] This spreading and development system are equipped with the conveyance device 3 for conveying a LCD substrate between the processing section 2 equipped with the cassette station 1 in which the cassette C which holds two or more substrates G is laid, and two or more processing units for performing a series of processings which include resist spreading and development in Substrate G, and the cassette C on the cassette station 1 and the

processing section 2. And carrying-in appearance of Cassette C is performed at the cassette station 1. Moreover, in the conveyance way 12 top in which the conveyance device 3 was formed along the array direction of a cassette, it has the movable conveyance arm 11 and conveyance of Substrate G is performed by this conveyance arm 11 between Cassette C and the processing section 2.

[0028] The processing section 2 is divided into pre-stage 2a and post-stage 2b, it has the conveyance way units 15 and 16 in the center, respectively, and each processing unit is arranged in the both sides of these conveyances way. And the junction section 17 is formed among these.

[0029] Pre-stage 2a is equipped with the movable main transport device 18 along with the conveyance way unit 15, 2 sets of heat-treatment units 21 which come to carry out a laminating to two steps of upper and lower sides, the adhesion process unit 22 which adjoined it and was formed up and down, and the refrigeration unit 23 are arranged at the one side of the conveyance way 15, and the washing unit 24 and the development unit 25 are arranged at the other side.

[0030] On the other hand, 3 sets of heat-treatment units 28 which post-stage 2b is equipped with the movable main transport device 19 along with the conveyance way unit 16, and come to carry out a two-step laminating to the one side of the conveyance way unit 16 are arranged, and the circumference resist removal unit 27 which removes the resist of the periphery of the resist spreading unit 26 and Substrate G is arranged at the other side of the conveyance way unit 16. The heat-treatment unit 28 performs the prebaking for stabilization of a resist, postexposure BEKU after exposure, and postbake processing after development. In addition, the interface section 30 for delivering Substrate G between aligners (not shown) is formed in the back end of post-stage 2b.

[0031] The cooling processing unit 29 which comes to carry out a two-step laminating is formed in the junction section 17 in the location which adjoined the heat-treatment unit 28, and the drug solution supply unit 81 and the transport-device admission passage 82 are established in the location which counters the cooling processing unit 29.

[0032] The above-mentioned main transport device 18 has carrying in and taking out of Substrate G to each processing unit of pre-stage 2a, and the function to deliver Substrate G between the junction sections 17 further while delivering Substrate G between the arms 11 of the conveyance device 3. Moreover, the main transport device 19 has carrying in and taking out of Substrate G to each processing unit of post-stage 2b, and the function to deliver the substrate G between the interface sections 30 further while delivering Substrate G between the junction sections 17.

[0033] Thus, by collecting each processing unit and unifying, space-savingizing and the increase in efficiency of processing can be attained.

[0034] Thus, it sets to spreading and the development system constituted. The substrate G in Cassette C is conveyed by the processing section 2. In the processing section 2 First, after washing processing was carried out by the washing unit 24 and stoving was carried out by one of the heat-treatment units 21. In order to raise fixable [of a resist], hydrophobing processing is carried out with an adhesion process unit 22, a resist is applied in the resist spreading unit 26 after cooling with a refrigeration unit 23, and the excessive resist of the periphery of Substrate G is removed in the circumference resist removal unit 27. Then, after prebaking processing of the substrate G is carried out by one of the heat-treatment units 28 and being cooled with a refrigeration unit 29, it is conveyed by the aligner through the interface section 30, and a predetermined pattern is exposed there. And it is again carried in through the interface section 30, and postexposure BEKU processing is performed by one of the heat-treatment units 28. Then, the development of the substrate G cooled with the refrigeration unit 29 is carried out in the development unit 25, and a predetermined circuit pattern is formed. The substrate G by which the development was carried out is held in the predetermined cassette on the cassette station 1 according to the main transport device 18 and the conveyance device 3.

[0035] Next, the heat-treatment units 21 and 28 as a thermal treatment equipment concerning the gestalt of this operation used for above-mentioned spreading and development system are explained. The case 31 where face the conveyance way 16 side and it has opening 31a as the heat-treatment units 21 and 28 are shown in drawing 2. Where the processing space 40 is formed between the hot plate 32 which heats the substrate G held in the case 31, and a hot plate 32 The shutter 50 which has been arranged so that the exhaust air covering 41 arranged so that the upper part of a case 31 may be covered, and the processing space 40 may be surrounded, and was formed possible [an attitude] to the exhaust air covering 41 is provided. And the

[0036] The hot plate 32 is formed with the aluminium alloy etc. In this example, the thickness of a hot plate 32 is formed in the rear-face side of a hot plate 32. It is laid under the hot plate 32 as by being pressed fit in two or more crevice 32a formed in 32d side of rear faces of a hot plate 32 as shown in nothing and drawing 3 (a) shows the shape of heater 33 pipe to drawing 3 (b).

[0037] Furthermore, the temperature sensor which is not illustrated is formed in a hot plate 32, and it feeds back to the control section which does not illustrate processing temperature, for example, a setup to a predetermined processing temperature of 120–150 degrees C is attained.

[0038] Four through tube 32b is prepared in the hot plate 32. The support pin 34 for supporting Substrate G at the time of substrate delivery, respectively is ****(ed) by these through tube 32b. The support pin 34 is held by the attachment component 35 in which the hot plate 32 was formed caudad. The attachment component 35 is connected with the elevator style (not shown). Therefore, the support pin 34 can appear frequently to surface 32c of a hot plate 32 by making it go up and down an attachment component 35 by the elevator style.

[0039] In addition, Substrate G may be a pro squeak tea type held in the upper part, without being laid in a hot plate 32 and contacting a hot plate 32 with the support pin 34 or a spacer (not shown).

[0040] In the case 31 of a thermal treatment equipment 26, the reflecting plate 60 which reflects the heat emitted from the hot plate 32 is formed. As shown in drawing 4, 32d of rear faces of a hot plate 32 is countered, and this reflecting plate 60 counters base section 60a arranged by separating a predetermined gap, and side 32e of a hot plate 32, and has side wall section 60b arranged by separating a predetermined gap.

[0041] A reflecting plate 60 is laid on the base member 63 laid on the base of a case 31, as shown in drawing 2. Furthermore, as shown in drawing 4, on base section 60a of a reflecting plate 60, a hot plate 32 is laid through a spacer 61. Thereby, between base section 60a of a hot plate 32 and a reflecting plate 60 is estranged. Although especially the gap between a hot plate 32 and a reflecting plate 60 is not limited, it is desirable to choose suitably so that the heat homogeneity of a hot plate 32 may become the highest.

[0042] The outer frame 62 is formed in surface 32c of a hot plate 32 so that some gap may be set and the perimeter of Substrate G may be surrounded. Although especially the height of an outer frame 62 is not limited, it is 5mm that what is necessary is just more highly than the height of the surface of Substrate G.

[0043] A shutter 50 consists of a configuration where inner sense level piece 50b was prepared in the upper limit of square shape tube main part 50a, as shown in drawing 5. The blanket 51 protrudes on the lower limit section of the center of both sides of this main part 50a, respectively. The blanket 51 is held free [rise and fall] by the guide member 52 set up by the base of a case 31, as shown in drawing 6. Furthermore, a blanket 51 is connected with the piston rod 54 of the air cylinder 53 as a rise-and-fall means, and rise-and-fall migration is constituted by the drive of an air cylinder 53 possible.

Therefore, you can make it able to go up and down a shutter 50, and it can be made to move to the exhaust air covering 40 by the air cylinder 53.

[0044] The stopper 55 is attached in the upper limit section of the guide member 52. This stopper 55 stops a blanket 51, when raising a blanket 51, and he stops a shutter 50 by the position. As shown in drawing 7, the rise halt location of a shutter 50 is set up so that Crevice D may be formed between a shutter 50 and the exhaust air covering 41.

[0045] In heat treatment using this heat-treatment unit 26, it exhausts as the so-called semi closed condition which the shutter 50 was raised most, and left Crevice D between the exhaust air covering 41 and a shutter 50, and was imperfectly intercepted in the processing space 40. Under the present circumstances, as shown in drawing 7, the air current (henceforth the supply air current A) supplied in the processing space 40 through Crevice D by exhaust air and the air current (henceforth the side air current B) which flows along with side 32e of a hot plate 32 arise. Among these, if there are many side air currents B, the heat of side 32e of a hot plate 32 will be taken too much, the temperature gradient between the core of a hot plate 32 and a periphery becomes large, heat homogeneity is spoiled, and the homogeneity within a field of the processing temperature of Substrate G gets worse as a result.

[0046] By the way, if exhaust air is fixed, if the supply air current A is made [many], the side air current B will decrease, and since the supply air current

A and the side air current B are produced with exhaust air as mentioned above, when the supply air current A is lessened, it has the relation whose side air current B increases on the contrary. The amount of the supply air current A can be fluctuated by changing the crevice D between the exhaust air covering 41 and a shutter 50. Therefore, the supply air current A is relatively made [many], and the side air current B is controlled according to this supply air current A, and Crevice D is set up so that the temperature gradient in a hot plate 32 may become small. Specifically, Crevice D is set as 15-20mm.

[0047] In addition, the exhaust air means which is not illustrated is connected to an exhaust port 42, and it is constituted so that the ambient atmosphere in the processing space 40 can be exhausted outside.

[0048] Since the heat-treatment unit 26 constituted as mentioned above has the reflecting plate 60 which reflects the heat emitted from the hot plate 32, when heat-treating to Substrate G, the emitted heat is reflected toward a hot plate 32. And since a reflecting plate 60 counters 32d of bases of a hot plate 32, and side 32e, respectively, is estranged to them and formed in them, it can reflect heat toward 32d of bases with much radiation of heat, and side 32e. Thereby, the local temperature fall of a hot plate 32, especially the temperature fall of the periphery of a hot plate 32 can be controlled. Consequently, the heat homogeneity of a hot plate 32 can be raised.

[0049] As shown in drawing 4, since arranging so that parts may overlap mutually can make the thermolysis from side 32b of a hot plate 32 perform moderately, side wall section 60b of a reflecting plate 60 and side 32b of a hot plate 32 have it. [desirable] In this case, it is desirable to set to 1 / 3 - 1/2 of thickness (this example 30mm) (this example 10-15mm) the height (henceforth lap height H) which both overlap. [of a hot plate 22] It is because the temperature of the periphery of a hot plate 32 will become high too much and the heat homogeneity of a hot plate 32 will be spoiled on the contrary by reflection of the heat emitted from the hot plate 32, if lap height H is too high.

[0050] Moreover, in the heat-treatment unit 26, since the outer frame 62 prepared in surface 32c of a hot plate 32 so that Substrate G might be surrounded stops that air goes into the perimeter of Substrate G, it can prevent that the temperature of the outside of Substrate G falls according to the flow of the air generated with exhaust air, and the so-called disturbance, consequently the homogeneity within a field of the processing temperature of Substrate G can be raised.

[0051] Moreover, the case where a shutter 50 is most raised in the heat-treatment unit 26 at the time of heat treatment. Since it is set up so that the crevice D between the exhaust air covering 41 and a shutter 50 may control the side air current B according to the supply air current A and the temperature gradient in a hot plate 32 may become small. It can prevent that heat is rapidly taken from side 32e of a hot plate 32 according to the rapid side air current B, and the temperature gradient between a center section and the periphery of a hot plate 32 can be made small. Therefore, the heat homogeneity of a hot plate 32 improves and the homogeneity within a field of the processing temperature of Substrate G improves as a result. In this case, in order to demonstrate such a function, it is desirable to set the crevice between the exhaust air covering 41 and a shutter 50 as 15-20mm.

[0052] Furthermore, since it is the so-called press fit type under which the heater 33 was made to lay by press fit, a hot plate 32 does not have constraint (40mm or more) of the thickness on manufacture like a cast type, and can be manufactured more thinly. Therefore, while being able to make a hot plate 32 thin and being able to improve heat responsibility, lightweight-ization can be attained and the height of the heat-treatment unit 26 can be reduced further. Thus, as the thickness of a hot plate 32 is thin, in view of the viewpoint of an equipment miniaturization and heat responsibility, it is more desirable. However, since it becomes easy to be influenced of disturbance in 25mm or less, the thickness of about 30mm is the optimal, for example, in view of both the miniaturization of equipment, and heat homogeneity.

[0053] In addition, although heat conduction was conventionally considered to worsen by the layer of the air which produces a press fit type hot plate between the crevices and heaters which were formed in the plate, it became clear in fact the effect of [such] accepted but for it to have been fully able to use.

[0054] The heat-treatment unit 26 concerning the gestalt of this operation can raise synthetically the homogeneity within a field of the processing temperature of Substrate G by combining the above-mentioned various technology as explained above. Specifically, heat homogeneity can be attained in a

* NOTICES *

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1. This document has been translated by computer. So the translation may not reflect the original precisely.

2. **** shows the word which can not be translated.

3. In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The perspective diagram showing spreading and the development system of the LCD substrate with which this invention is applied.

[Drawing 2] The cross section showing the thermal treatment equipment concerning the gestalt of operation of this invention.

[Drawing 3] The cross section showing a condition before and after pressing a heating heater fit in a hot plate.

[Drawing 4] The cross-section perspective diagram showing the hot plate of the thermal treatment equipment of drawing 1.

[Drawing 5] The perspective diagram showing the shutter of the thermal treatment equipment of drawing 1.

[Drawing 6] The cross section showing the elevator style of the shutter of the thermal treatment equipment of drawing 1.

[Drawing 7] The cross section showing the condition of the shutter at the time of heat treatment with the thermal treatment equipment of drawing 1.

[Drawing 8] The cross section showing the modification of the gap adjustment means between exhaust air covering and a shutter.

[Description of Notations]

21 28 -- Heat-treatment unit

31 -- Case

32 -- Hot plate

33 -- Heating heater

34 -- Support pin

35 -- Attachment component

40 -- Processing space

41 -- Exhaust air covering

42 -- Exhaust port

50 -- Shutter

51 -- Blanket

52 -- Guide member

53 -- Air cylinder

54 -- Piston rod

55 -- Stopper

60 -- Reflecting plate

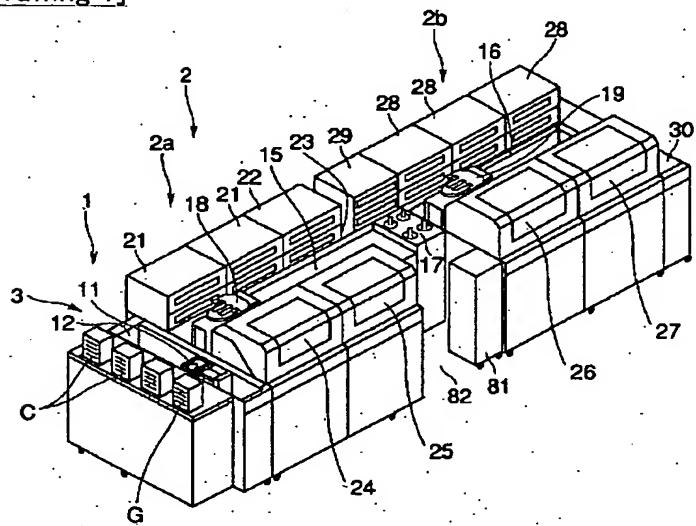
61 -- Spacer

62 -- Outer frame

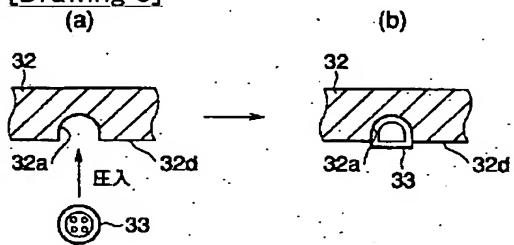
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DRAWINGS

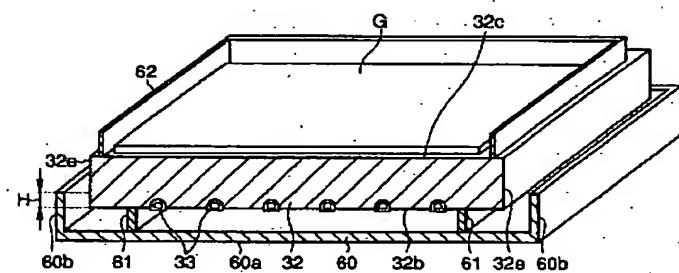
[Drawing 1]



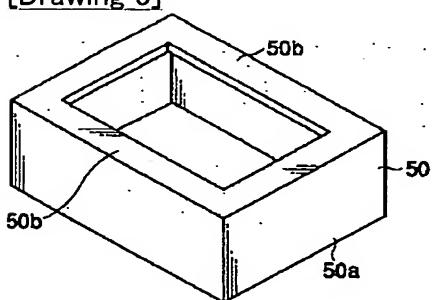
[Drawing 3]



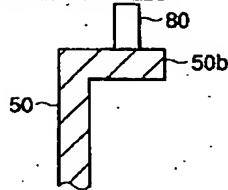
[Drawing 4]



[Drawing 5]

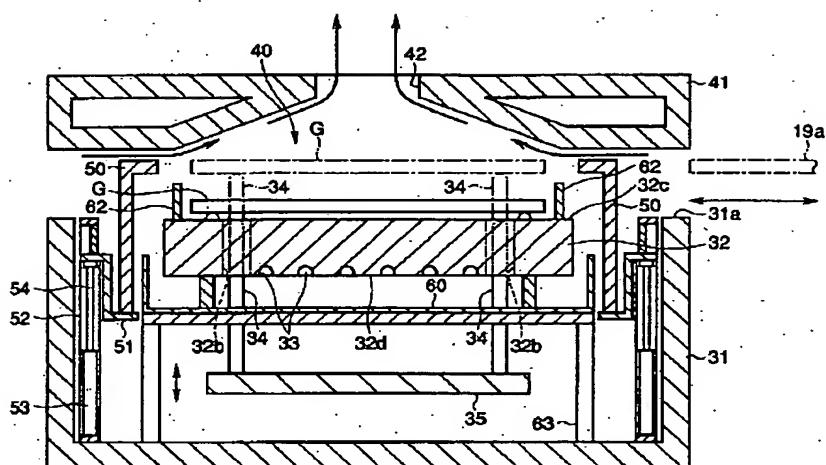


[Drawing 8]

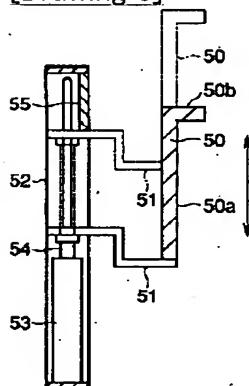


[Drawing 2]

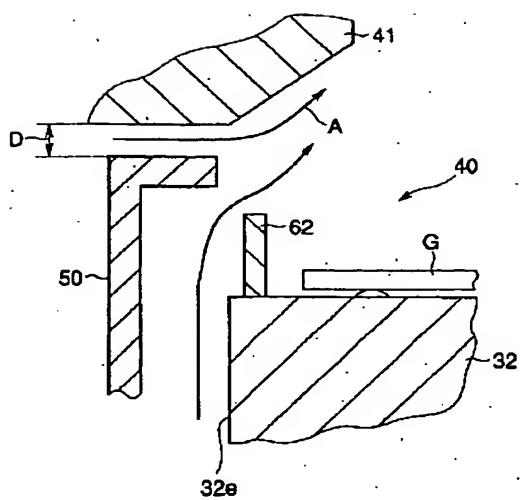
26



[Drawing 6]



[Drawing 7]



[Translation done.]